PATENT SPECIFICATION

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(19)

(54) IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF PIGMENTED PLASTICS STRUCTURAL MEMBERS

(71) We, DYNAMIT NOBEL AKTIENGESELLSCHAFT, a German company, of 521 Troisdorf, Near Cologne, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the manufacture of pigmented structural members formed of a synthetic thermoplastic plastics material, advantageously polyvinyl chloride and intended for use in the building industry, for example in the production of, *inter alia*, window frames and facade plates by extrusion, deep-drawing or injection moulding.

Structural members intended for external use in building construction, including, in particular, facade plates, window and door frames, are often formed of synthetic thermoplastic plastics materials. In many cases, visual requirements make it desirable for these structural members to be light coloured, for example white or beige. However, there is frequently a demand for the structural members to be given other colours, for example varying shades of grey, whcih may be as dark as charcoal. A problem which arises with structural members having a darker colouring is that irradiation by the sun's rays can cause surface temperatures far about 70°C to occur in the structural members. Such elevated temperatures in such structural members, and especially in facade plates, can lead to the setting up of inherent stresses in the material. Furthermore, such elevated temperatures tend to reduce the resistance of the plastics material to weathering. Thus, it has been found that window sections formed of polyvinyl chloride (PVC) start to contract or shrink to a measurable degree at temperatures from 60°C upwards, permanent changes in dimensions occurring as the temperatures increase. In addition, structural members made from synthetic thermoplastic plastics materials, such as PVC, are also subject to thermal expansions, the extent of which depends on the differences of the mean temperatures of the material. Under particularly unfavourable circumstances, installed window frames can become irreparably unsuitable for their intended use. This may well occur if the permanent shrinkages caused by excessive heating have added thereto reversible contractions under the low temperatures experienced in winter.

In addition to distortions caused by such externally acting factors, distortion of structural members can result from the different expansions in different parts of the members resulting from different temperatures in the interior and exterior of the members. Furthermore, another material factor with structural members of synthetic plastics is the elasticity modulus of the material which is dependent on temperature. Thus, with impact-tough hard PVC, the elasticity modulus is from 25,000 to 26,000 kp/cm² at a temperature of 23°C, falls to about 20,000 kp/cm² at 45°C, to about 15,500 kp/cm² at 60°C and it falls to an even greater extent above 60°C. Hence, when structural members consisting of impact-tough hard PVC are too strongly surface heated, by the sun's rays, there is the danger that deformation arising from the inherent weight of the material because of the strong decrease in the elasticity modulus will be added to the deformation which results from the inherent tension.

This behaviour of synthetic thermoplastic plastics materials has hitherto greatly restricted the use thereof in the building industry, especially when they possess a dark colour when their use in the formation of structural members has largely been precluded.

According to one aspect of the present invention, there is provided a synthetic thermoplastic plastics moulding composition which comprises at least one pigment which absorbs a major part of visible light incident thereon and which causes remission of at least 35% of infra-red radiation incident thereon at substantially all wavelengths in the wavelength range of 2250 to 750 nm.

According to a second aspect of this in-

vention, there is provided a process for the production of a structural member for external use in the building industry which comprises shaping as a said structural member a synthetic thermoplastic plastics composition which comprises at least one pigment which absorbs a major part of visible light incident thereon and which causes remission of at least 35% of infra-red radiation incident thereon at substantially all wavelengths in the wavelength range of 2250 to 750 nm.

It is pointed out that our Patent Application No. 44504/73 (Serial No. 1444562) of earlier date describes and claims an extruded synthetic thermoplastic plastics profiled section member adapted for use in the construction of a window or door frame, which member is covered on at least a surface thereof which, when a said frame is used in a building structure can lie on the outside thereof, with a coextruded layer of a homopolymer or copolymer of methyl methacrylate which contains at least one pigment of the type to be used in moulding compositions of the present invention.

By the use of such pigments, for example, in synthetic plastics moulding compositions from which are made window frame members, door frame and panel members, and facade plates, it is possible to reduce the temperature rise in the structural members under the action of the sun's rays however dark the colour of the structural members. This is in marked contrast to conventionally coloured structural members which do not have particularly marked infra-red reflection. Thus, the surface temperatures of structural members produced from moulding compositions according to the present invention, can be comparable to those achieved with very light-coloured thermoplastics materials, which generally undergo very slight heating up so that they meet practical requirements. With the structural members which are produced from moulding compositions in accordance with the present invention, it is possible to avoid both the initiation of inherent stresses caused by excessive temperatures and the formation of excessive deformations. Hence, a dark-coloured structural member produced according to the present invention can remain in satisfactory use even when subject to strong and continuous irradiation by the sun. This is of particular advantage since darker structural members do not show dirt as badly as light coloured structural members and are thus desirable members to be used in locations having dirty atmospheres.

The pigments used in the moulding compositions of the present invention to impart a dark colour thereto which can range, for example, from grey through charcoal to black, and which cause remission of infra-red radiation are preferably used in an amount of from 0.2 to 5% by weight of the thermoplastic moulding composition to which they are added. The processing and mixing of the pigments with the thermoplastic moulding composition to which they are added can be, for example, carried out in a conventional mixer, from which this composition is then fed to an extruder, which extrudes the composition into the form of structural members, e.g. section members.

A group of pigments which have been found to be particularly suitable for use in those moulding compositions according to the present invention from which grey to black, and in particular, charcoal coloured structural members are to be produced are black pigments based on Sb_2S_2 and Sb_2S_3—$Sb_2(SO_4)_3$ in a black modification. Such pigments strongly absorb visible light, while reflecting well infra-red radiation. Other pigments which exhibit similar behaviour are black anthraquinone pigments.

The absorption behaviour in the infra-red range of polyvinyl chloride structural members pigmented so that they were charcoal in colour is reproduced in the accompanying drawings in which the percentage remission of infra-red radiation is plotted on the ordinates against the wavelength in nanometers of radiation to which the structural members were subjected. The structural members were window parts which were subjected to diffused lighting so that identical conditions obtained during each test. Figure 1 relates to a test carried out using a conventional black pigment and shows that very little infra-red radiation remission occurred. Figure 2 shows the infra-red radiation remission by four PVC window frames coloured using an antimony sulphide black pigment and indicates that high infra-red radiation remission took place. The various curves in figure 2 reflect identical tests carried out using a number of window frames made from different PVC moulding compositions. Little effective variation in the curves took place from one PVC batch to another. Figure 3 shows the pattern of infra-red radiation remission obtained when using an anthraquinone black pigment in two different PVC moulding compositions.

It is clear from the drawings that both antimony sulphide and anthraquinone black pigments are suitable for use in the process of this invention. More particularly, it can be seen from the drawing that these pigments cause at least 35% remission of infra-red radiation at substantially all wavelengths in the wavelength range 2250 to 750 nm, as required of pigments used in the practice of the present invention.

This high remission of infra-red radiation by structural members which are manufactured from the synthetic thermoplastic plastics moulding compositions coloured in accordance with the invention, by the extrusion method or the deep-drawing method results in the

structural members undergoing reduced heating when used out-of-doors as will now be described in the following example in which structural members according to the present invention and structural members pigmented in conventional manner were subjected to strong sun irradiation.

EXAMPLE.

Comparison measurements were made of the surface temperatures of section members formed of hard PVC which are coloured in the conventional manner and coloured according to the present invention, when subjected to relatively long exposure to sunshine on a Summer day. The results obtained are set out in the following table. The section member F1 was a conventional structural member coloured white with 4% by weight titanium dioxide and 0.01% by weight of prepared carbon black colouring, related to the weight of synthetic plastics composition used in the formation of the section member; the section member F2 is a conventional, charcoal-coloured structural member coloured with 0.5% by weight titanium dioxide and 0.5% by weight of prepared carbon black pigment. The section member F3, on the contrary, is coloured a dark charcoal colour by use of 2% by weight of antimony black pigments. The heating up of the different section members under the effect of the sun which can be seen from the table, shows that the section member F3 coloured according to the invention exhibits a substantially lower surface temperature than the conventionally coloured section member F2. The white section member F1 is, in effect, a control test indicating surface temperature variations when the section member is white.

It can therefore be concluded that the range of uses of structural members pigmented according to this invention is broadened with respect to conventionally pigmented structural members.

TABLE

Surface temperatures with sun irradiation (°C)

Date and Location	Time of Day	Surface Temperature (°C)		
		F1	F2	F3
20.7.1972	14.00	39	55	48
Troisdorf, Germany	14.15	38	52	46
	14.30	41	61	51
	14.45	40	53	43
	15.00	40	56	49
	15.15	37	51	45
	15.30	39	56	48
	15.45	40	56	50

WHAT WE CLAIM IS:—

1. A synthetic thermoplastic plastics moulding composition which comprises at least one pigment which absorbs a major part of visible light incident thereon and which causes remission of at least 35% of infra-red radiation incident thereon at substantially all wavelengths in the wavelength range of 2250 to 750 nm.

2. A composition as claimed in Claim 1, which comprises polyvinyl chloride as main or sole thermoplastic plastics component.

3. A composition as claimed in Claim 1 or 2, which comprises said at least one pigment in an amount of from 0.2 to 5% by weight.

4. A composition as claimed in any one of Claims 1 to 3, which is coloured from grey to black by the pigment.

5. A composition as claimed in Claim 4, in which said at least one pigment is constituted by Sb_2S_3 or Sb_2S_3—$Sb_2(SO_4)_3$ in a black modification for imparting a grey to black tone thereto.

6. A composition as claimed in Claim 4, in which said at least one pigment is a black anthraquinone pigment.

7. A synthetic thermoplastic plastics moulding composition as claimed in Claim 1, substantially as described herein.

8. A process for the production of a structural member for external use in the building industry which comprises shaping as a said structural member a synthetic thermoplastic plastics composition which comprises at least one pigment which absorbs a major part of visible light incident thereon and which causes remission of at least 35% of infra-red radiation incident thereon at substantially all wavelengths in the wavelength range of 2250 to 750 nm.

9. A process as claimed in Claim 8, in which the shaping is effected by extrusion.

10. A process as claimed in Claim 8, in which the shaping is effected by deep-drawing.

11. A process as claimed in Claim 8, in which the shaping is effected by injection moulding.

12. A process as claimed in any one of Claims 8 to 11, in which said composition comprises polyvinyl chloride as sole or main thermoplastic plastics component.

13. A process as claimed in any one of Claims 8 to 12, in which said composition comprises said at least one pigment in an amount of from 0.2 to 5% by weight.

14. A process as claimed in any one of Claims 8 to 13, in which the pigment colours said composition from grey to black

15. A process as claimed in any one of Claims 8 to 14 in which said at least one pigment is a black pigment constituted by Sb_2S_3 or Sb_2S_3—$Sb_2(SO_4)_3$ in a black modification.

16. A process as claimed in any one of Claims 8 to 14, in which said at least one pigment is a black anthraquinone pigment.

17. A process for the production of a structural member as claimed in Claim 8, substantially as described herein.

18. A structural member whenever produced by the process claimed in any one of Claims 8 to 17.

19. A structural member as claimed in Claim 18, which is a window frame member, door frame or panel member or a facade plate.

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3 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

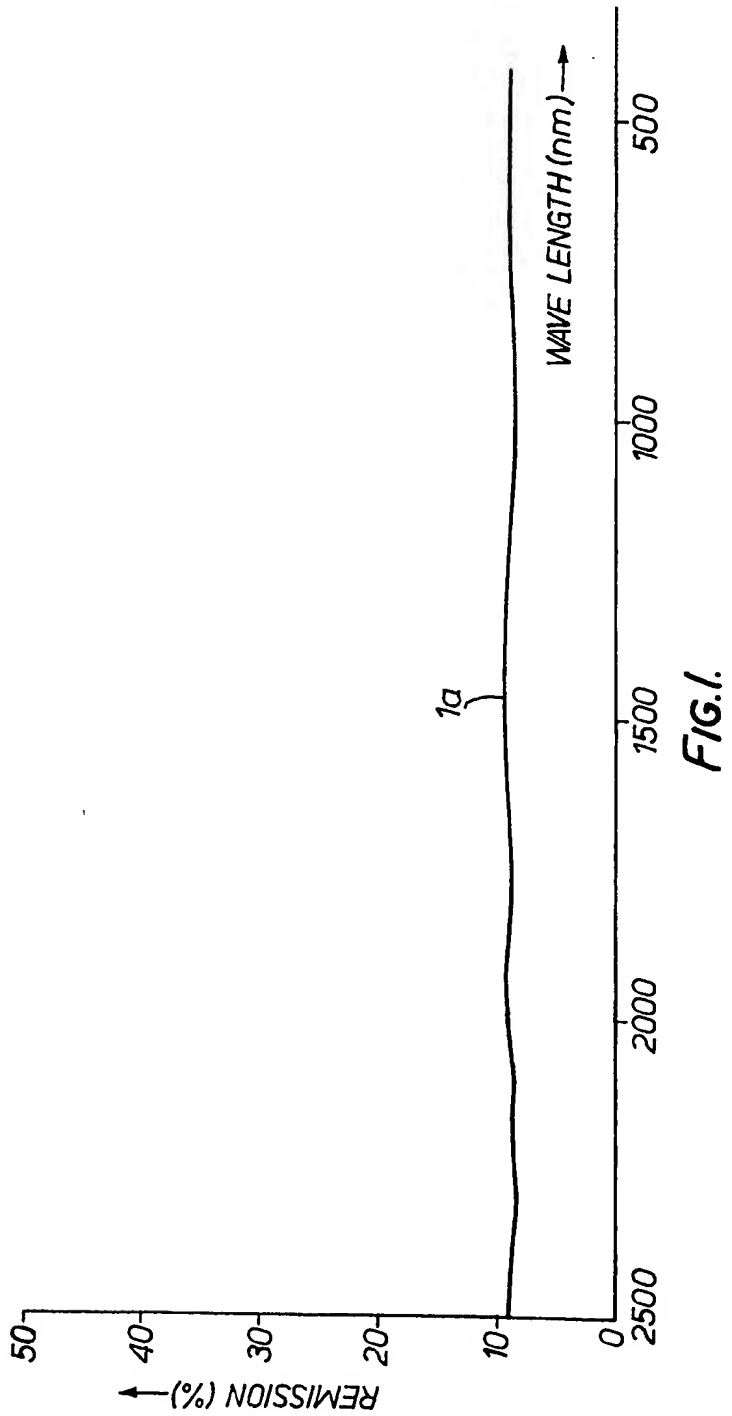

FIG. 1.

1 444 563 COMPLETE SPECIFICATION
3 SHEETS

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SHEET 2

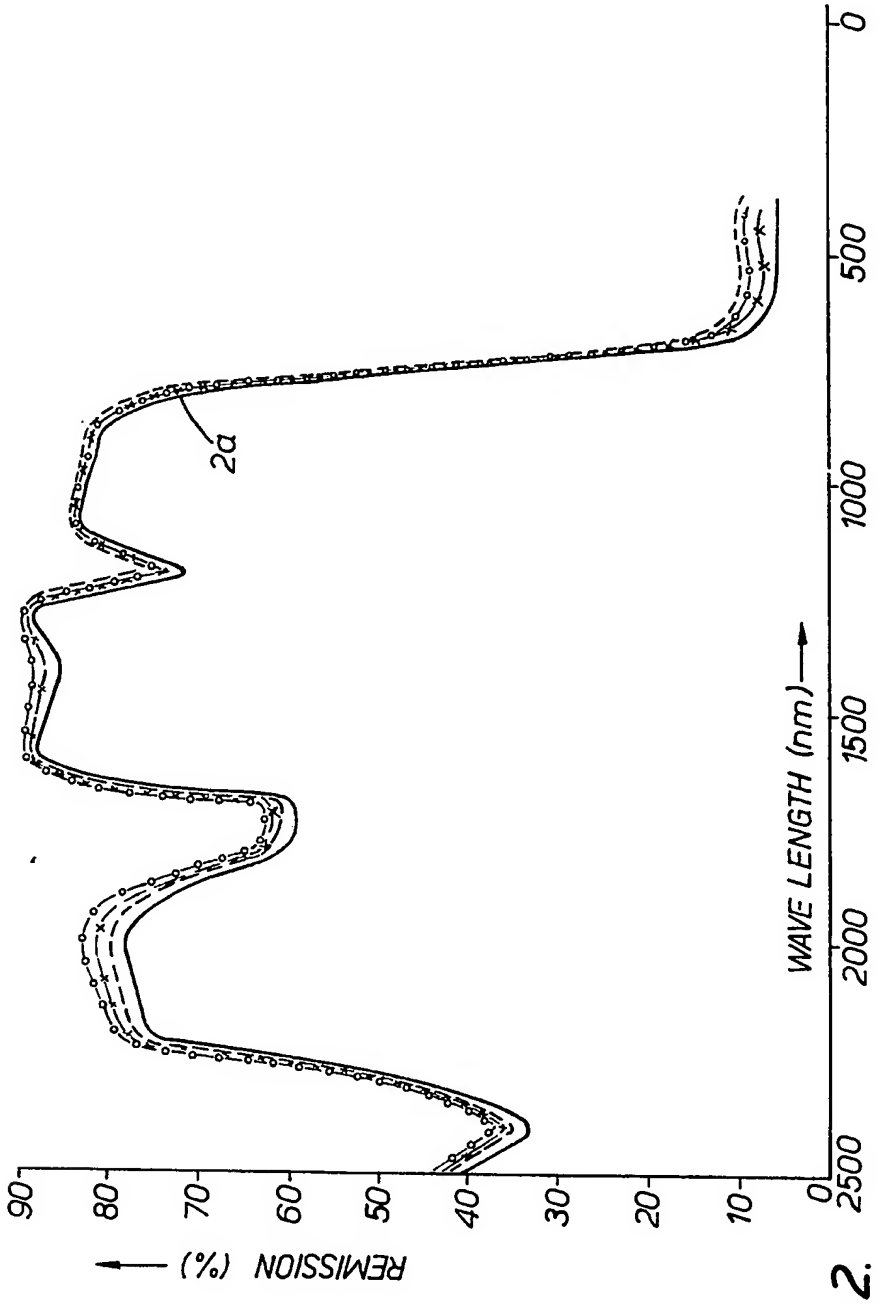

FIG. 2.

1 444 563 COMPLETE SPECIFICATION
3 SHEETS
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SHEET 3

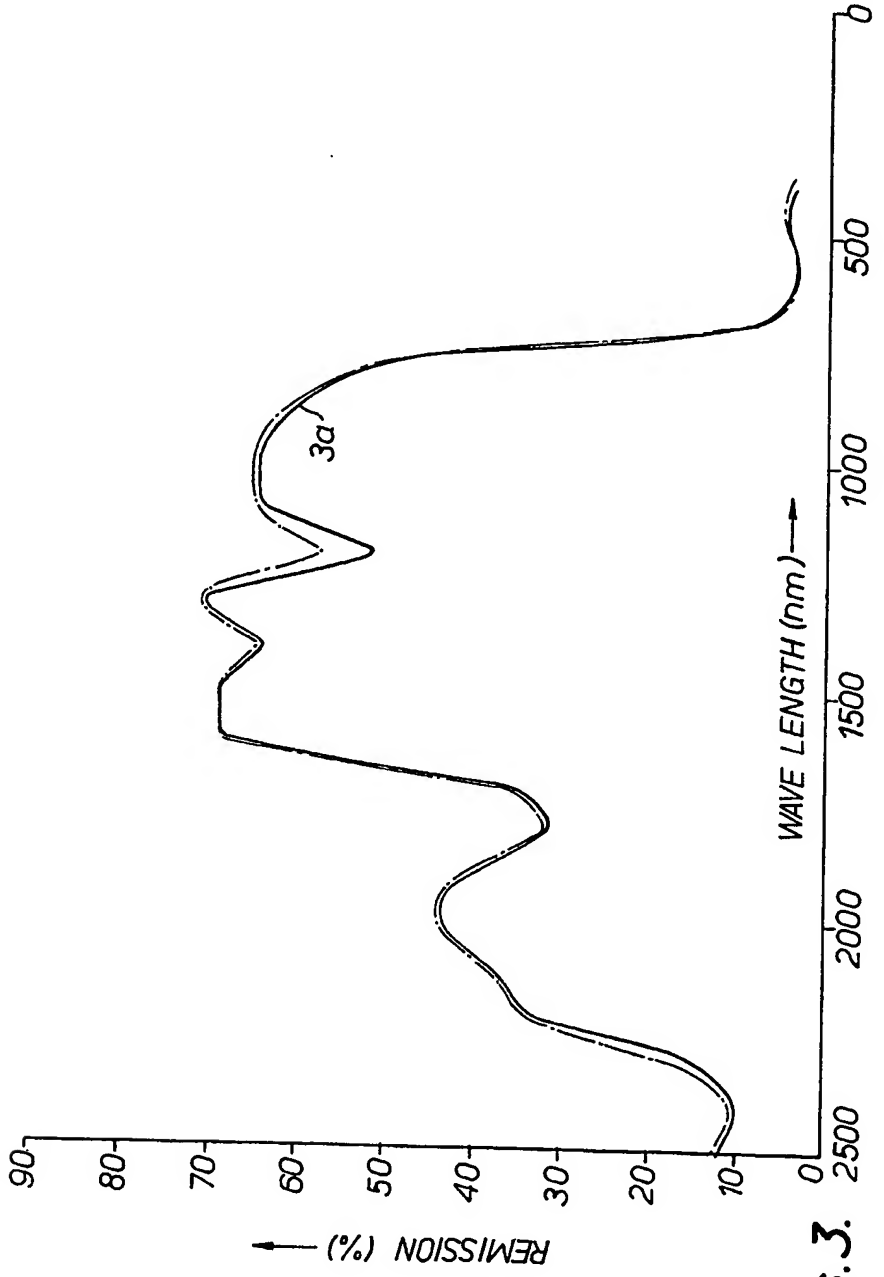

FIG. 3.